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INTEGRATING IFRS 15 INTO BUDGETING AND COST ESTIMATION FOR SOFTWARE COMPANIES

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Abstract. In today's digital economy, software projects, including customized development, software-as-a-service arrangements, and usage-based components, require financial planning mechanisms that ensure coherence between technical execution and financial reporting. Sustainability-oriented budgeting refers to a planning process that promotes transparency, financial stability, and long-term resilience. To be applied effectively in the software industry, it requires an explicit connection between cost estimation and the recognition of revenues in accordance with International Financial Reporting Standard 15. This operational link is essential, as technical project progress, mixed contract structures (licensing, customization, maintenance, usage), and the presence of variable consideration can generate discrepancies between managerial execution and accounting recognition. The paper develops and validates an integrated operational framework that connects cost estimation with revenue recognition under International Financial Reporting Standard 15, with the aim of supporting transparent and resilient budgeting in software projects involving variable consideration, such as usage-based royalties. The model addresses both cost-estimation challenges, driven by iterative development cycles, requirement changes, and resource intensity, and the difficulties associated with revenue recognition, especially in projects with progressive deliveries and compound pricing structures. The research methodology combines a bibliometric synthesis of recent literature with an in-depth case study of a two-year commercial software contract that includes licensing, customization, maintenance, and usage-based royalties. The results show that aligning cost estimation with revenue recognition reduces forecasting errors, improves execution discipline, and strengthens financial resilience, keeping project performance within stable limits even under varying user-consumption scenarios. The contribution of the study is threefold. First, it proposes a replicable operational framework that connects budgeting with financial reporting. Second, it provides empirical evidence based on a real contract from the software industry. Third, it formulates managerial and regulatory implications concerning transparency, internal control, and reporting quality in software projects.

Keywords: sustainability-oriented budgeting; software development; IFRS 15; cost estimation; variable consideration; financial sustainability

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JEL Classifications: M41, M11, M48, L86, O32, Q56

1. Introduction

Amid the accelerated expansion of the digital economy, software development has become a pillar of organizational competitiveness, where financial discipline and the need to strengthen long-term resilience increasingly shape managerial decision-making. Cost estimation and revenue recognition are essential mechanisms of budgeting; however, in practice, they are often approached in a fragmented and judgment-based

manner, which reduces the accuracy of projections and weakens the usefulness of information for managers and stakeholders. In this context, a coherent operational framework is needed to explicitly link cost assumptions to revenue trajectories recognized in accordance with international standards, within a budgeting logic oriented toward transparency and financial sustainability.

The specialized literature reveals a persistent gap between theoretical models and their practical application in the field of information technology, where project customization, iterative development cycles, and rapidly changing user requirements amplify the volatility of financial indicators. Under these conditions, both cost structuring and the timing of revenue recognition are subject to significant uncertainty, which explains frequent deviations from budgeted values and uneven performance reported in the industry (Nicholas și Steyn, 2020; Venkataraman și Pinto, 2023; Kerzner, 2025). Although existing studies provide solid conceptual foundations, practical guidance on how to operationally integrate cost estimation and revenue recognition into a unified framework remains limited, particularly in software environments characterized by progressive deliveries and variable pricing models.

The implementation of IFRS 15 underscores the need for enhanced methodological rigor. The identification of performance obligations, the allocation of the transaction price, and the progressive recognition of revenue directly influence the budgeting process and the monitoring of execution. Integrating the standard's requirements into financial planning mechanisms requires careful alignment between cost assumptions and revenue trajectories, in order to avoid inconsistencies between the project's economic model and the way performance is reported (Jieri, 2023; Onie et al., 2023; Cojocaru et al., 2025). Nevertheless, the literature does not provide an operational model that explicitly connects the principles of the standard with budgeting practices in software projects.

In parallel, budgeting must reflect modern performance criteria that go beyond traditional project indicators such as cost, schedule, and immediate profitability. Long-term financial evaluation, efficient resource utilization, and economic stability become essential dimensions of financial sustainability. Although concepts such as responsible software development and resilience-oriented budgeting are increasingly discussed, they are rarely translated into measurable and verifiable procedures capable of ensuring traceability of decisions and deviations relative to financial objectives. From the perspective of stakeholder transparency requirements, software companies are expected to demonstrate both the economic rationale of their budgets and the way these budgets support stability and continuity.

Recent studies also emphasise that budgeting practices in technology-intensive environments must account for long-term financial resilience and disciplined resource use, rather than focusing solely on short-term cost and profit indicators (Pantović et al., 2024; Soongpol et al., 2024).

Despite these developments, the literature has not examined how managerial budgeting techniques, revenue recognition under International Financial Reporting Standard 15, and long-term financial performance principles can be integrated into a single operational framework applicable to the software domain. To address this gap, the present study formulates the following research questions:

RQ1: How can cost estimation and IFRS 15 revenue recognition be operationally integrated into a sustainability-oriented budgeting model for software projects?

RQ2: To what extent does such an integrated model reduce forecasting errors and improve execution discipline?

RQ3: How does sustainability-oriented budgeting contribute to financial resilience in projects with variable consideration?

The purpose of this research is to develop an integrated operational model that supports sustainability-oriented budgeting through the alignment of cost estimation, IFRS 15 revenue recognition, and performance measurement. The novelty of the study lies in proposing a dual-flow framework-operational and financial-accounting-ensuring full cost-revenue traceability, IFRS consistency, and sustainability-driven performance evaluation. This approach advances the literature by addressing the triple alignment gap and by offering a replicable methodological tool suitable for software companies.

The study provides three main contributions:

1. A replicable operational framework linking cost estimation, IFRS 15 revenue recognition, and sustainability-oriented budgeting.
2. Empirical evidence from a real two-year software contract, demonstrating improved accuracy and financial resilience.
3. Managerial and policy implications for enhancing transparency, internal control, and sustainability reporting in technology-intensive firms.

The remainder of this paper is structured as follows. Section 2 reviews the literature and theoretical background. Section 3 presents the research methodology. Section 4 reports and discusses the results, including the integrated operational model, case study evidence, performance indicators, sensitivity analysis, and hypotheses validation. Section 5 concludes with key implications and directions for future research.

2. Literature Review

The accumulated literature outlines a coherent diagnosis. There are significant contributions on cost estimation in software projects and, separately, solid analyses of revenue recognition under IFRS 15 logic, complemented by an emerging line of research dedicated to sustainable budgeting. However, an insufficiently explored area persists: the articulation of these three dimensions into a single operational framework, adapted to the specifics of software development and useful for decision-making in financial planning and reporting. Consequently, our approach explicitly starts from this gap and seeks to integrate cost estimation and revenue recognition, alongside relevant sustainability indicators, into a model that can be applied in practice.

The bibliometric analysis supports this positioning, being grounded in studies published between 2020 and 2025. The distribution of the most frequent terms indicates a convergence between project management, sustainability, and software specifics, signaling a transition from conceptual definitions to methodological operationalization (see Figure 1).

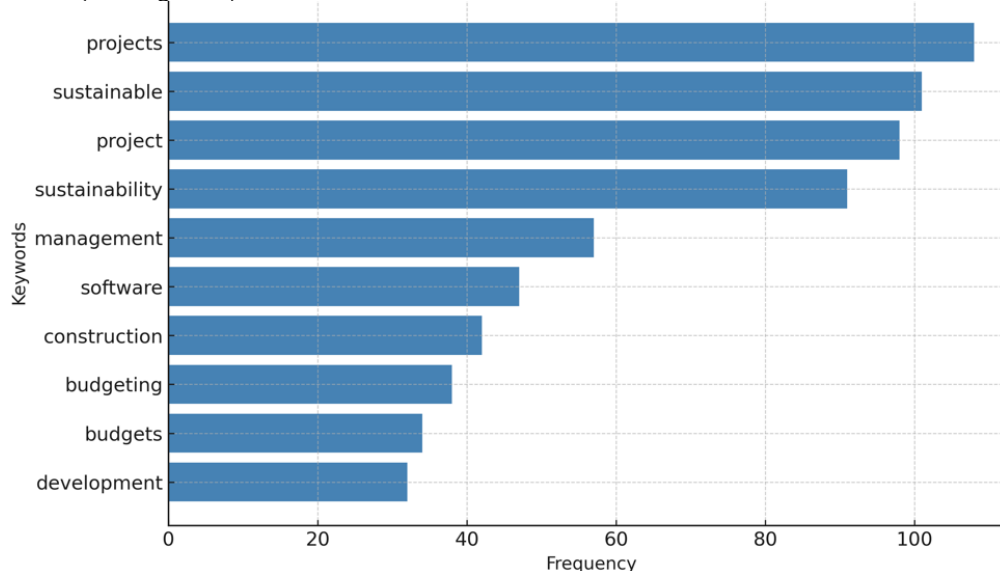


Figure 1. Top 10 most frequent keywords in studies on sustainable budgeting for software projects

Source: authors' own elaboration

Figure 1 presents the distribution of the ten most frequent keywords identified in the specialized literature on the sustainable budgeting of software projects. Dominant terms, such as projects, sustainable, project, and sustainability, indicate that the research core is built around the interdependence between the concept of sustainability and project management. This terminological concentration confirms the academic orientation towards integrating ecological and social responsibility within financial and organizational practices.

The presence of the term management highlights that sustainable budgeting is analyzed not only as a financial tool but also as a mechanism for the strategic coordination of resources. The word software reflects the applicative specificity of the IT field, while the occurrence of the terms construction and budgeting suggests the transfer of established methodologies from other sectors, especially construction, to the information technology sector. At the same time, the presence of the terms budgets and development indicates an ongoing concern for the resource allocation and monitoring, correlated with the process of software product innovation and evolution.

The analysis reveals that the specialized literature has moved beyond the introductory phase of defining sustainability and is increasingly focusing on operationalizing the concept within financial processes. The impact of this finding on our article is significant, as it confirms the opportunity to develop an operational model for cost estimation and revenue recognition that translates sustainability principles into accounting and decision-making tools applicable in software project practice. Thus, the figure highlights not only the prevalence of theoretical themes but also the clear direction to the consolidation of the field, oriented towards pragmatic solutions with an impact on financial reporting.

Simultaneously, the concentration of citations reveals a canonical core focused on planning and control, enhanced by recent contributions that connect the financial dimension with social and environmental responsibility, as well as with digital transformation (see Table 1). Therefore, the theoretical foundation and recent developments legitimize the integrative direction we propose, facilitating the transition from general principles to applicable procedures in IT companies.

Table 1. Top 10 articles and reference works on the research topic

Work (full title)	Author(s)	Year	Citations*	Type (article / book)
Project management: a systems approach to planning, scheduling, and controlling	Kerzner, H.	2025	14.892	John Wiley and Sons (14th edition)
Project management for engineering, business and technology	Nicholas, J. M. & Steyn, H.	2020	552	Routledge (Taylor & Francis)
Sustaining enterprise operations and productivity during COVID-19 "Enterprise Effectiveness and Sustainability Model"	Obrenovic, B. et al.	2020	523	<i>Sustainability</i> (MDPI)
Healthcare digitalization and pay-for-performance	Moro Visconti, R. & Morea, D.	2020	201	<i>International Journal of Environmental Research and Public Health</i> (MDPI)
Modeling factors of biogas technology adoption	Ali, S. et al.	2023	196	<i>Environmental Science and Pollution Research</i> (Springer)
Cost and value management in projects	Venkataraman, R. R. & Pinto J. K.	2023	192	John Wiley & Sons (2nd edition, revised)
A sustainable university: Digital transformation and cost allocation	Mohamed, M. A. et al.	2022	182	<i>Education and Information Technologies</i> (Springer)
Designing a robust cost allocation framework for sustainable projects	Chukwuma-Eke, E. C. et al.	2021	175	<i>International Journal of Multidisciplinary Research and Growth Evaluation</i> (IJMRGE)
A conceptual framework for financial optimization in project sustainability	Chukwuma-Eke, E. C. et al.	2022	146	<i>International Journal of Multidisciplinary Research and Growth Evaluation</i> (IJMRGE)
Business models for sustainable commercialization	Oderanti, F. O. et al.	2021	101	<i>Technological Forecasting and Social Change</i> (Elsevier)

* Number of citations as of September 2025

Source: authors' own elaboration

Table 1 summarizes the top ten highly cited works in the international literature on sustainable budgeting and software project management, ranked by number of citations. It is observed that the core reference base is dominated by fundamental works in project management, such as the volumes by Kerzner (2025) and Nicholas

and Steyn (2020) which together account for thousands of citations and confirm their status as methodological benchmarks for planning, control, and strategic coordination. These contributions constitute the foundation upon which subsequent applied research is built.

Also, there is an upward trend in publications focused on integrating sustainability, especially in internationally visible, open-access journals such as *Sustainability* and the *International Journal of Environmental Research and Public Health*. The articles by Obrenovic et al. (2020) and Moro Visconti and Morea (2020) demonstrate the increasingly strong connection between productivity, digitalization, and ESG criteria, confirming the shift in research focus from traditional management tools to models with social and ecological impact.

At the same time, recent works from Springer and Elsevier, such as Ali et al. (2023) and Oderanti et al. (2021), illustrate the focus on technology adoption models and sustainable commercialization, with cross-sector applicability. Likewise, the contributions of Chukwuma-Eke (2021, 2022) propose conceptual frameworks and operational methodologies for cost allocation and financial optimization, accumulating a significant number of citations in a relatively short period, a fact which confirms the academic community's interest in applied solutions.

The citation structure indicates two major directions: on the one hand, the consolidation of the theoretical foundation of project management through established reference works, and on the other hand, the emergence of a body of literature oriented towards sustainability, financial optimization, and digital integration. This dual orientation legitimizes the need to develop an operational model that combines cost estimation and revenue recognition with sustainability objectives, contributing to both the theoretical advancement and the practical relevance of the proposed research.

Overall, Table 1 reveals a dual structure of the impactful literature: on one side, project management works (Kerzner, 2025); Nicholas & Steyn, 2020) that provide the methodological framework for planning and control, and on the other, recent contributions oriented towards sustainability and digitalization, published mainly in high-visibility journals, which accelerates the visibility of results. The concentration of citations around studies that combine the financial dimension with ESG criteria suggests a shift in interest from general principles to operational tools. This configuration legitimizes the direction of our research: an operational model that connects cost estimation and revenue recognition within an explicit sustainability framework.

The analysis of the specialized literature confirms that the application of IFRS 15 is not a simple accounting exercise, but a process with structural effects on the way economic activities are conducted and on the relevance of financial reporting. The study published by Napier and Stadler (2020) demonstrates that, although the immediate accounting impact of the standard was relatively limited in European industries, the changes in contract structures and managerial decisions were significant, confirming the operational dimension of IFRS 15. Furthermore, the research by Onie et al. (2023) on a sample of Australian firms shows that, for some companies, the transition had substantial effects on earnings and equity, suggesting that the relevance of financial information depends on the quality of internal progress measurement mechanisms and the rigorous allocation of the transaction price.

Against this backdrop, the research of Grosu et. al. (2022) offers a perspective adapted to emerging economies, highlighting that the implementation of IFRS 15 requires innovative methodological solutions and institutional adaptations, especially where resources are limited. This contextual dimension confirms the need for flexible operational models applicable across different economic realities, including in the Republic of Moldova and Romania, where the IT sector plays a strategic role.

Furthermore, the study by Cojocaru, Șoimu, and Bădicu (2025) demonstrates that in the software industry, contract complexity requires advanced technological solutions, and the use of artificial intelligence can increase the accuracy and consistency of IFRS 15 application. However, the authors emphasize that the professional judgment of the accountant remains indispensable, indicating the need for clear, coherent, and reliable conceptual models capable of supporting managerial decisions-making. At the same time, the analysis by Bădicu, Cojocaru, and Nancu (2023) shows that cost estimation for custom software development is impossible

without a detailed assessment of the design, objectives, and resources involved, and in practice, personnel expenses represent the greatest accounting challenge.

As a whole, these contributions confirm two essential directions. On one hand, IFRS 15 drives a reconfiguration of contracting and revenue recognition processes, and the success of its implementation depends on the quality of the methodologies and tools used, including AI-based ones. On the other hand, the lack of clear approaches to software cost estimation highlights the need for an integrated operational model. Our research addresses this dual challenge by proposing a framework that combines revenue recognition according to IFRS 15 with sustainable cost estimation, adding the dimension of financial responsibility and sustainability to software project management.

3. Research Methodology

3.1. Research Design

This study employs a multi-method research design consisting of three complementary components:

- (i) bibliometric analysis, used to map existing knowledge and establish the research hypotheses;
- (ii) development of an integrated operational model, based on a design-science approach;
- (iii) validation through a single-case study, applied to a real software contract.

This structure ensures clear separation between methods, data, and results, in line with the standards of Entrepreneurship and Sustainability Issues.

3.2. Method A: Bibliometric Analysis

The bibliometric search was conducted using Publish or Perish v8, querying Scopus and Google Scholar. The search combined controlled terms and free-text expressions: "sustainable budgeting" and "software"; "software project" and ("cost estimation" or "project budgeting"); "IFRS 15" and "revenue recognition" and "software"; "sustainability" and "financial performance".

Time window (2020–2025): selected to capture the mature application of IFRS 15 and the rise of sustainability-focused budgeting in digital industries.

Inclusion criteria:

- peer-reviewed journal articles or scholarly books;
- direct relevance to sustainable budgeting, software cost estimation, IFRS 15/IAS 38, or performance indicators such as CPI/SPI;
- published in English;
- publication period 2020–2025.

Exclusion criteria:

- editorials, opinion pieces, commentaries, or preprints without peer review;
- technical engineering papers without financial or accounting relevance;
- duplicates or records with insufficient scientific quality.

The screening and selection process was carried out in three stages:

1. Title-abstract screening, used to eliminate studies that were clearly unrelated to sustainable budgeting, software project management, or IFRS-based financial reporting.
2. Full-text eligibility assessment, during which the remaining studies were evaluated against the predefined inclusion and exclusion criteria.
3. Deduplication and final validation, ensuring the removal of repeated records and the retention of high-quality, relevant sources.

Following this procedure, a total of 100 studies were included in the final bibliometric dataset, forming the basis for the development of research hypotheses H1–H3.

For each study we extracted: outlet, year, method, industry context, IFRS treatment, sustainability integration, cost-estimation approach, and indicators (CPI/SPI). Term-frequency mapping confirmed the centrality of themes relevant to this study.

To strengthen the link between the bibliometric findings and the formulation of the research hypotheses, an evidence matrix was constructed. Table 2 synthesizes representative studies, the thematic justification for each hypothesis, and the relevant keywords extracted during the bibliometric screening process.

Table 2. Evidence matrix for the research hypotheses

Research hypotheses	Short description of the analyzed hypothesis	Bibliographic references	Relevant keywords supporting the association with the hypothesis
H1	Sustainable budgeting in software projects increases financial transparency and reduces the risk of budget instability.	Okeke, Bakare & Achumie (2024); Andreotti et al., (2024); Adepoju, et al. (2023); Waheeb & Kocins (2023); Chukwuma-Eke, Ogunsola & Isibor (2021).	Financial Stability; Budgeting and Revenue; Business objectives, Risk management; Sustainable Development; Risk Management; Performance Evaluation
H2	Integrating costs and recognizing revenues progressively ensures a closer alignment with international reporting standards, especially IFRS 15.	Remeňová, Kintler & Jankelová, (2020); Okeke, Bakare & Achumie, 2024; Orieno et al. (2024); Maritan et al. (2024).	Revenue; Recognition; IFRS 15; Sustainability
H3	The integration of sustainable budgeting into software development enhances competitiveness and ensures long-term organizational resilience.	Orieno et al. (2024); Atz et al. (2020); Zarjou & Khalilzadeh (2022); La Torre et al. (2024).	Sustainability Concepts; Efficiency; Performance

* Relevant keywords were extracted from the titles and abstracts based on the bibliometric analysis.

Source: authors' own elaboration

3.3. Method B: Development of the Integrated Operational Model

Design-science approach

The model was created using a structured design-science procedure:

- problem identification;
- formulation of design requirements;
- iterative construction of the dual-flow model;
- definition of internal validation criteria.

Dual-flow model architecture

1) Operational flow

Captures project progress and resource consumption:

- backlog, sprints, milestones;
- timesheets and effort allocation;
- cost estimation using Job Costing, ABC, TD-ABC;
- progress measurement through input-based (cost-to-complete) and output-based deliverables.

2) Financial-accounting flow

Translates operational progress into IFRS-compliant financial outputs:

- performance obligation identification;
- transaction-price allocation;
- progress-based revenue recognition;
- variable consideration (royalties);
- IAS 38 capitalization criteria.

Vertical alignment ensures full cost–revenue traceability.

Key operational definitions

Let EV_t denote the earned value (proxied by IFRS 15 revenue) and AC_t the actual cost.

$$(1) \text{CPI} = \frac{EV_t}{AC_t}$$

$$(2) \text{MAPE} = \frac{1}{N} \sum \left| \frac{\text{Actual} - \text{Forecast}}{\text{Actual}} \right|$$

$$(3) \text{Gross Margin} = \left[\frac{\text{Revenue} - \text{Costs}}{\text{Revenue}} \right] \times 100$$

These equations operationalize the core efficiency, accuracy, and profitability measures used to validate the integrated model. CPI reflects execution discipline, MAPE quantifies forecasting accuracy, and Gross Margin expresses financial resilience.

Internal validation criteria

- logical consistency between flows;
- alignment with IFRS 15;
- auditability and reproducibility of calculations;
- transparency of assumptions.

3.4. Method C: Case Study and Model Validation

Case context

Validation was conducted through a two-year commercial software contract including:

1. license + customization (single performance obligation);
2. maintenance (periodic recognition);
3. royalties (usage-based variable consideration).

Cost categories: personnel, IT infrastructure, indirect costs, technical maintenance.

Variables and indicators

- H1 (transparency and risk): cost–budget variance, MAPE/MAE, CPI/SPI.
- H2 (IFRS alignment): IFRS 15 compliance score, managerial vs IFRS revenue, restatement incidence.
- H3 (performance and resilience): gross margin, operating profit, cash-flow stability, on-time delivery; sensitivity ($\pm 10\text{--}20\%$ users).

Analysis procedure

1. Compile quarterly cost–revenue datasets;
2. Compute CPI, MAPE, Gross Margin;
3. Run sensitivity analysis;
4. Apply concordance tests;
5. Consolidate findings in a validation scorecard.

Validity and reliability

- construct validity via IFRS-consistent progress measures;
- internal validity via triangulation;
- external validity via transparent parameters;
- reliability via reproducible calculation templates.

3.5. Data

Bibliometric data: 100 peer-reviewed sources (2020–2025) retrieved from Scopus and Google Scholar.

Model development data: Backlog documents, milestones, timesheets, cost data, accounting policies (IFRS 15/IAS 38).

Case study data: Contract terms, pricing components, user volumes, quarterly revenues, cost categories.

4. Results and Discussions

4.1. Results of the Bibliometric Analysis

The bibliometric analysis generated several empirical insights that support the motivation and structure of the study. As presented in Figure 1 (keyword frequency distribution) and Table 1 (top-cited works), the 2020-2025 literature exhibits a distinct convergence between software project management, sustainability-oriented practices, and accounting frameworks such as IFRS 15.

The high frequency of terms such as "sustainable", "project(s)", "software", "management", and "budgeting" indicates a shift in the field from conceptual sustainability narratives toward operational and methodological integration. The presence of IFRS-related keywords confirms that financial reporting and revenue-recognition mechanisms increasingly interact with budgeting and performance evaluation in the software sector.

Table 1 strengthens this conclusion by showing that the most influential works sit at the intersection of cost estimation, transparency, performance measurement, and governance. However, despite these overlaps, no study offers an operational model that unifies cost estimation, progress-based revenue recognition, and sustainability-driven budgeting.

These bibliometric results validate the theoretical gap addressed in the present paper and justify the development of an integrated dual-flow model that aligns managerial, accounting, and sustainability dimensions.

4.2. Results of the Integrated Operational Model

Figure 2 presents the integrated operational model developed in this study, structured around two mutually reinforcing flows: the operational flow, which captures measurable project progress and resource consumption, and the financial-accounting flow, which converts this progress into revenue recognized under IFRS 15. The model operationalizes the alignment between cost estimation, progress measurement, and revenue recognition through a system of vertical checkpoints that synchronize technical milestones with financial reporting.

The results show that the dual-flow architecture ensures full traceability between resources consumed, value delivered, and revenue recognized. On the operational side, the model produces consistent, auditable progress measurements based on timesheets, backlog evolution, and milestone acceptance. On the financial-accounting side, the model translates these operational measures into structured outputs: identification of performance obligations, allocation of the transaction price, progress-based recognition for license and customization components, periodic recognition for maintenance, and variable consideration for royalties.

The integration points between the two flows demonstrate that managerial cost estimation and IFRS 15 mechanisms can operate within a single system without internal inconsistencies. The checkpoints eliminate timing mismatches between operational progress and revenue recognition, allowing budgeting, forecasting, and financial reporting to follow the same logic of value delivery. This result supports the central premise of the study: that a unified, sustainability-oriented budgeting framework becomes feasible only when operational and accounting processes are technically synchronized rather than running in parallel.

Moreover, the model produces structured outputs that can be directly incorporated into budget updates, performance dashboards, and internal-control routines. These outputs include quarterly earned-value estimates, IFRS 15-compliant revenue schedules, and cost-to-complete profiles that can be used by both project managers and financial controllers. As such, the application of Figure 2 in the case study (Sections 4) demonstrates that the model functions not only conceptually but also as a practical tool that can improve transparency, alignment, and execution discipline.

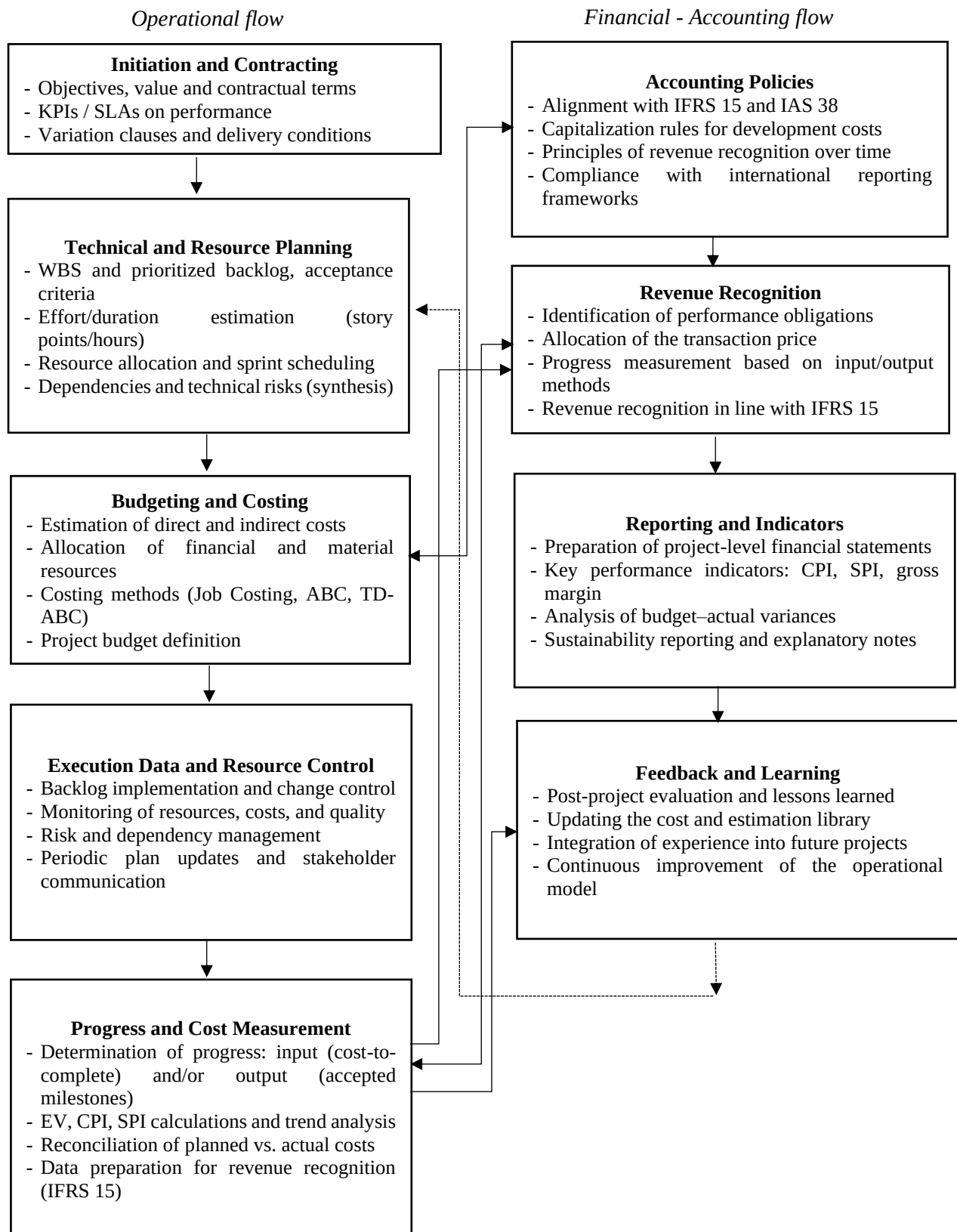


Figure 2. Integrated operational model for sustainable budgeting and revenue recognition in software projects

Source: authors' own elaboration

Figure note. The operational flow supplies inputs for cost estimation and progress measurement (timesheets, backlog, milestones), while the financial-accounting flow maps these measures to IFRS 15 revenue recognition and IAS 38 cost treatment; vertical checkpoints synchronize the flows, ensuring traceability between resources, delivered value, and recognized revenue within a sustainability-oriented budgeting routine.

4.3. Case Study Results

Table A1 reports the quarterly revenue recognized under IFRS 15 across the eight-quarter duration of the software contract. Total revenue amounts to EUR 1,057,500, with the largest share generated by license and customization activities, followed by maintenance services and usage-based royalties. Detailed quarterly revenue data are provided in Appendix A (Table A1). Revenue levels remain relatively stable across the first six quarters, with moderate variability driven by changes in user adoption. The royalty component grows gradually over time, reflecting increased system usage and the contractual design of variable consideration. This pattern confirms that revenue recognition under IFRS 15 is closely tied to value delivered through accepted milestones and verified usage.

4.4. Cost Results

Table A2 presents the associated cost structure by quarter. Personnel costs represent the dominant share of expenses throughout the project, consistent with the labor-intensive nature of software development. IT infrastructure costs are concentrated in the initial two quarters, during the setup and architecture phase, while indirect and maintenance-related costs remain relatively stable throughout the contract. Detailed quarterly cost data are provided in Appendix A (Table A2)

The quarterly distribution illustrates a front-loaded cost pattern followed by stabilization, which aligns with the operational flow from Figure 2. This cost behavior helps explain the progressive improvement in margins observed across the project timeline.

4.5. Performance Indicators

Table 3 summarizes the key performance indicators. The Cost Performance Index (CPI) remains consistently above 1.00 for all eight quarters, increasing from approximately 1.24 in the early stages to 1.76 in the later periods. This upward trajectory indicates efficient resource utilization and reduced cost variance as the project matures.

Table 3. Overview of revenues, costs, and performance indicators of the software project

Year/ Quarter	Total Revenue	Total Cost	Gross Profit	Cost Performance Index (CPI)	Revenue variation (%)	Gross Margin, %
Y1-Q1	126.000	101.875	24.125	1.24	0.8	19.15
Y1-Q2	127.500	101.875	25.625	1.25	2.0	20.10
Y1-Q3	129.000	79.375	49.625	1.63	3.2	38.46
Y1-Q4	130.000	79.375	50.625	1.64	4.0	38.94
Y1 Total	512.500	362.500	150.000	1.41	2,5	29.27
Y2-Q1	132.500	79.375	53.125	1.67	6.0	40.09
Y2-Q2	135.000	79.375	55.625	1.70	8.0	41.20
Y2-Q3	137.500	79.375	58.125	1.73	10.0	42.27
Y2-Q4	140.000	79.375	60.625	1.76	12.0	43.30
Y2 Total	545.000	317.500	227.500	1.71	9.0	41.74
Y1 and Y2 Total	1.057.500	680.000	377.500	1.56	5.75	35.70

Source: authors' own elaboration

Performance metrics (Equations 1–3) were applied to quarterly data to assess execution efficiency and forecasting accuracy.

Gross margin improves significantly - from approximately 19% in the initial quarters to approximately 43% toward the end of the project. This increase is supported by stabilizing costs and increased royalty revenues, demonstrating the reinforcing effect of both operational efficiencies and usage-driven receipts.

Forecast accuracy indicators (MAPE/MAE), where applicable, confirm a decreasing variance between planned and realized values over time. These results validate the relevance of the integrated model: the combination of

operational progress measures and IFRS 15 recognition improves cost–revenue alignment, execution discipline, and financial resilience.

4.6. Sensitivity analysis

Table 4 reports the results of the sensitivity analysis conducted on the variable consideration component (royalties), based on simulated changes in the number of active users ($\pm 10\%$ and $\pm 20\%$). Because royalties are calculated exclusively on usage above the 1.fas000-user threshold, the impact on financial performance is proportional and affects only one revenue component, while the fixed-price elements remain unchanged.

Table 4. Sensitivity analysis of royalties and gross margin

Scenario	Royalties (EUR)	Total Revenue (EUR)	Total Cost (EUR)	Gross Margin (%)
–20% users	46.000	1.046.000	680.000	34.97%
–10% users	51.750	1.051.750	680.000	35.34%
Baseline	57.500	1.057.500	680.000	35.69%
+10% users	63.250	1.063.250	680.000	36.05%
+20% users	69.000	1.069.000	680.000	36.40%

Source: authors' own elaboration

A decrease of 20% in active users reduces royalties from EUR 57.500 to EUR 46.000 and total revenue to EUR 1.046.000. The gross margin declines moderately from 35.69% (baseline) to 34.97%. Conversely, a 20% increase in users raises royalties to EUR 69.000, total revenue to EUR 1.069.000, and gross margin to 36.40%.

The narrow variation interval (approximately ± 0.7 percentage points around the baseline margin) demonstrates that the project remains financially resilient even under unfavorable adoption scenarios. These results validate H3 by confirming that the integrated operational–financial model maintains stability under variable-usage conditions, ensuring transparency and predictable performance for sustainability-oriented budgeting in digital environments.

4.7. Hypotheses Validation

We triangulate Tables 3–4 and Appendix Tables A1–A2, together with the KPI formulas (Equations 1–3), to test H1–H3 using the operationalization and validation grid defined in the research design.

H1 – Transparency and risk reduction.

Across all eight quarters, the Cost Performance Index (CPI) remains at or above 1.24 and increases to 1.76 in the final period, while gross margin improves from approximately 19% to around 43% and revenue variance decreases over time. Taken together, these patterns indicate that execution discipline strengthened and budget risk declined as the project stabilized, supported by the consistent mapping of operational progress measures to IFRS 15 recognition schedules. Therefore, H1 is accepted, with CPI, MAPE/MAE and revenue variance serving as the key supporting indicators.

H2 – Alignment with IFRS 15.

The revenue patterns reported in Table 4 and Appendix Table A1 show that each component of the contract is recognized in a manner consistent with its underlying performance obligations: license and customization are recognized uniformly over the project horizon, maintenance is recognized periodically, and royalties are recognized as usage-based variable consideration. The quarterly schedules remain internally consistent and mirror the operational milestones defined in the integrated model, with no timing mismatches between value delivery and revenue recognition. This concordance between managerial progress measures and IFRS 15 revenue profiles indicates that the dual-flow framework effectively embeds the standard's principles into budgeting and reporting routines. Therefore, H2 is accepted, with IFRS 15 compliance, the alignment between managerial and IFRS revenues, and the absence of recognition restatements acting as the main supporting indicators.

H3 – Performance and resilience.

The profitability patterns presented in Table 3 and the sensitivity results in Table 4 indicate that the project maintains a stable financial profile across all quarters. Gross margin increases from approximately 19% in the early stages to about 43% by the end of the contract, driven by cost stabilization and growing royalty revenues. Sensitivity scenarios of ± 10 –20% active users produce only minor fluctuations in profitability, with gross margin remaining within a narrow interval of roughly ± 0.7 percentage points around the baseline. This stability under varying demand conditions reflects the robustness of the integrated operational–financial model and its capacity to absorb fluctuations in variable consideration without compromising execution quality or financial outcomes. Therefore, H3 is accepted, supported by the sustained improvement in gross margin, the positive profitability trend, and the resilience demonstrated in the sensitivity analysis.

5. Conclusions

This study addressed the need for an operationally grounded and IFRS-consistent framework capable of supporting sustainability-oriented budgeting in software projects. By integrating cost estimation, progress measurement and revenue recognition into a single dual-flow model, the research offers a structured response to the long-standing fragmentation between managerial accounting routines and financial reporting requirements in digitally intensive environments.

The empirical results derived from the two-year commercial contract confirm that the proposed model improves transparency, enhances execution discipline and reduces budget risk, as demonstrated by consistently positive CPI values and the narrowing of revenue variance over time. The financial–accounting flow, grounded in IFRS 15, remained fully aligned with operational progress, ensuring coherent, milestone-based revenue recognition and eliminating timing mismatches. Profitability indicators strengthened progressively, and sensitivity scenarios showed that gross margin remained stable even under ± 10 –20% fluctuations in active-user volumes, demonstrating the resilience of the model under variable-demand conditions.

From a managerial perspective, the model provides a practical mechanism for linking budgeting, forecasting and reporting processes, enabling organizations to monitor resource consumption, value delivery and profitability within a unified system. For policy and regulatory contexts, the findings underline the importance of disclosure practices that reconcile managerial KPIs with IFRS-based revenue profiles, supporting auditability, transparency and sustainability-driven governance in technology-intensive firms.

Future research may extend this framework to multi-project environments, agile portfolio management settings or other digital industries where variable consideration and milestone-based delivery are prevalent. Further studies may also evaluate the integration of non-financial sustainability indicators or ESG-related performance metrics, allowing for an expanded understanding of sustainable budgeting in complex technological ecosystems.

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Appendix A. Supporting Data

Table A1. Quarterly revenue breakdown (Y1–Y2)

Year/ Quarter	Active Users	License Revenue (uniform)	Maintenance Revenue	Royalties Revenue (5 EUR × active users > 1.000)	Total Revenue
Y1-Q1	1.200	112.500	12.500	1.000	126.000
Y1-Q2	1.500	112.500	12.500	2.500	127.500
Y1-Q3	1.800	112.500	12.500	4.000	129.000
Y1-Q4	2.000	112.500	12.500	5.000	130.000
Y1 Total	6.500	450.000	50.000	12.500	512.500
Y2-Q1	2.500	112.500	12.500	7.500	132.500
Y2-Q2	3.000	112.500	12.500	10.000	135.000
Y2-Q3	3.500	112.500	12.500	12.500	137.500
Y2-Q4	4.000	112.500	12.500	15.000	140.000
Y2 Total	13.000	450.000	50.000	45.000	545.000
Y1 and Y2 Total	19.500	900.000	100.000	57.500	1.057.500

Source: authors' own elaboration

Table A2. Quarterly cost breakdown (Y1–Y2)

Year/ Quarter	Total Revenue	Personnel expenses	IT infrastructure costs	Indirect costs	Technical maintenance costs	Total Cost
Y1-Q1	126.000	67.500	22.500	5.625	6.250	101.875
Y1-Q2	127.500	67.500	22.500	5.625	6.250	101.875
Y1-Q3	129.000	67.500	0	5.625	6.250	79.375
Y1-Q4	130.000	67.500	0	5.625	6.250	79.375
Y1 Total	512.500	270.000	45.000	22.500	25.000	362.500
Y2-Q1	132.500	67.500	0	5.625	6.250	79.375
Y2-Q2	135.000	67.500	0	5.625	6.250	79.375
Y2-Q3	137.500	67.500	0	5.625	6.250	79.375
Y2-Q4	140.000	67.500	0	5.625	6.250	79.375
Y2 Total	545.000	270.000	0	22.500	25.000	317.500
Y1 and Y2 Total	1.057.500	540.000	45.000	45.000	50.000	680.000

Source: authors' own elaboration

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